Overview of Prime Mineral Content of Indian Green Leafy Vegetables and a Proposed Non-Invasive Technical Method of Their Estimation

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Abstract— Green leafy vegetables contain lots of minerals, nutrients and dietary fibers. They play vital role in maintaining good health. In this fast pacing life, we need to give importance to good diet. Compositions of green leafy vegetables are needed to be evaluated for all references. There are many in-vitro and physico-chemical methods available for this purpose. Many of such methods of estimating mineral content of Indian green leafy vegetables are discussed in this paper. A non-invasive technical method for the estimation of mineral and nutrients is also proposed in this paper. The proposed method uses UV and visible radiation for the detection of absorption and reflection property of the test specimen. Hence, an instrument/system for this method can be easily implemented.

Key words: Green Leafy Vegetables, Methods for Estimation

I. Introduction

Life style of human being has changed a lot in this modern world. We are running for work and food. Most of the time, we ignore the need for good diet. Due to this, the average life span has changed. Immunity to diseases has also decreased. The green leafy vegetables have high water content, mineral, nutrient and also dietary fibers which are required for human good health. Leafy vegetables are low in calories and hence, ideal for weight management also. They are useful in reducing the risk of cancer and heart disease since they are low in fat, high in dietary fiber, and rich in folic acid, vitamin C, potassium and magnesium, as well as containing a host of phytochemicals, such as lutein, beta-cryptoxanthin, zeaxanthin, and beta-carotene [1].

II. Composition of Green Leafy Vegetable and Available Methods for Estimation

The average composition of vitamins, nutrients, minerals (iron, manganese) is found to be high in grooving (nurturing) plants. After the sowing, from 2nd week to 4th week its iron and manganese content increases [2].

Indian green leafy vegetables have very good antioxidant property. The roll of antioxidant property on human health is abundant. Thus, they provide protection to human health from dangerous diseases and viral infections. Some of Indian green leafy vegetables are studied for their antioxidant activity by Sheetal Gupta *et al*. The study reveals that the green leafy vegetable Murraya Koenigi has the heighest antioxidant activity (2961.78µmol of ascorbic acid/g sample) and Centella asiatica has the least antioxidant activity (623.78µmol of ascorbic acid/g sample). Methanolic extracts of these samples at multiple concentrations were studied for their antioxidant activity in different systems [3].

Tender edible green leafy vegetables are tested to know their bio-availability extractives. The crude protein was ranged from 15.7 to 28.5%, ether 1.5 to 6.5%, ash 9.2 to 20.4%, sucrose, raffinose, stachyose content was found to be very high in Drumstic 5.6%, Neem 3.2% and Colocasia 2.2%. The iron constituents in some conventional and non-conventional green leafy vegetables were estimated by Kaushalya Gupta *et al.* They are Amaranthus with 712.5 ppm, Colocasia with 100.0 ppm, Drumstic with 225.0 ppm, Fenugreek with 312.5 ppm, Neem with 262.5 ppm and Pumkin with 350.0 ppm [4].

Moringa Oleifera leaf exhibits natural antioxidant property. It is an Indian traditional plant used for pharmacological actions. It is tested for two different maturity stages, namely, tender leaves and mature leaves, to evaluate its anti-oxidant property in vitro. Leaves at both stages exhibit free radical scavenging effect. The study suggests that the extracts of Moringa oleifera both mature and tender leaves have potent antioxidant activity against free radicals, prevent oxidative damage to major bio-molecules and afford significant protection against oxidative damage [5].

Iron is essential for human body which involves in metabolism, oxygen circulation and also gives resistance/tolerance power to a body, when there is lack in supply of required nutrients and 15% of the body's iron is stored for future needs and utilized when dietary supply is inadequate [6].

The deficiency in the supply of iron may affect brain nervous system (neurotransmitters). Doctors suggest for the consumption of more green leafy vegetables in the food to the people suffering from diabetes. Among the underutilized green leafy vegetables identified iron content ranged from 3.68 to 37.34mg/100g. The highest iron content was observed by the authors in Nelabasale soppu, Portulaca Deracea followed by Annesoppu, Celosia Argentea(28.26mg) and Naroli soppu, Duranta Repeus (27.25mg). By including these irons rich greens in daily food around 25% of iron which is required for human body will be fulfilled. Inadequate/lack in consumption of green leafy vegetables in diet will lead to deficiency of vitamin A and iron. An attempt is made to identify and analyze various underutilized green leafy vegetables for their nutrient content from selected regions of Karnataka [7].

The metal ions of physico-chemical form have an effective influence on their absorption by the body. Foods contain a large number of legends for metal ions such as proteins, peptides, amino-acids, carbohydrates, in the diet form soluble and insoluble complexes with minerals and trace elements under gastrointestinal conditions affecting their bio-availability. It may be taken as/influenced negatively by dietary fiber, phytic acid, oxalic acid, tannins and phosphates. Since iron is poorly absorbed from the diet, much of research is focused on the bio-availability. Knowledge on the bio-availability of calcium is considered

to be important in view of the prevention of chronic disease related to calcium, viz. hypertension and osteoporosis [8].

Copper, zinc, iron and manganese contents were determined in edible parts of some fresh vegetables. The study and the tests are reported by researchers on several samples collected at different time intervals. Such study is made on three parts of the vegetable, namely, leaves, roots and fruits. Atomic flame absorption method was used to determine copper, zinc, iron and manganese concentration. The highest content of copper and zinc were found in roots of celeriac and cabbage leaves respectively. The concentration of zinc was high in lettuce leaves and low in tomato fruit. The copper content was found to be more in 1993 than in 2005 in all vegetables. In case of zinc also it was found to be high in vegetables and also in edible parts of the fruits comparatively in 2005. The iron content in the leek leaves was found to be high, but, in tomato and cucumber it was found to be low. The manganese was found low in roots of the carrot and high in lettuce leaves. In the leaves and fruits of vegetables the iron content was high in 1993 than in 2005 but root vegetables were found to be containing more iron in 2005.The manganese content was found to be high in 1993 compared to 2005 in the vegetable species [9].

The total iron (Fe) content in black tea was determined by Mandal S. *et al*. by mineral digestion and spectrophotometric method. According to this, the total iron content varies from 21.3mgFe/kg to 37.6mgFe/kg in black tea. This spectrophotometric method is used for analysis of total iron content in plants also. This method includes digestion and oxidation with nitric acid and sulphuric acid mixtures while preparing and it is sensitive one [10].

In this analysis the iron present in an iron tablet (dietary supplement) or a sample of food is extracted to form a solution containing Fe3+ (ferric) ions. To make the presence of these ions in solution visible, thiocyanate ions (SCN−) are added. These react with the Fe3+ ions to form a blood-red coloured complex. The reaction is given in equation 1.1.

$$Fe3+ (aq) + SCN−(aq) \rightarrow [FeSCN]2+(aq) \quad (1.1)$$

By comparing the intensity of the colour of this solution with the colours of a series of standard solutions, with known Fe3+ concentrations, the concentration of iron in the tablet or food sample may be determined [11]. Santanu Bhattacharjee *et al*. have conducted an extensive study on mineral element composition of spinach. They have used 22 spinach samples and analysed 16 different elements such as Na, K, Fe, Mn etc using inductively coupled plasma and atomic absorption spectophotometric (ICP-AAS). The result shows that Na, K, Mg constitute major while P, Ca and Al contribute sub-major and Fe, Zn, M as trace matrix in spinach sample [12].

There are many reports of analysis of some green leafy vegetables in the literature. All these are off shelf type or in-vitro type and hence they are not suitable for non-invasive and instantaneous way of detection of iron content. Hence, we propose such one method here.

III. PROPOSED NON-INVASIVE METHOD

The proposed system is non-invasive because that it uses a UV and visible electromagnetic radiation which is not harmful to the test specimen.

Fig. 1 depicts the method. A microcontroller or an ARM processor with required number of peripherals can be used as processor. A stable dual source consisting of Deuterium (Di) and a tungsten lamp is to be used for the purpose of emitting UV and visible radiation respectively.

The source selection is to be made sequential by the electronic processor. Leaf holder is a chamber to accommodate the leafy vegetable part and it is a motor driven chamber, controlled by the processor. The absorption property of the test specimen is scanned in both UV and visible range first. The absorption spectra of the given specimen in both ranges are to be compared with the standard data stored in the processor for that species of leafy vegetable. Similarly, the processor will invoke visible radiation source.

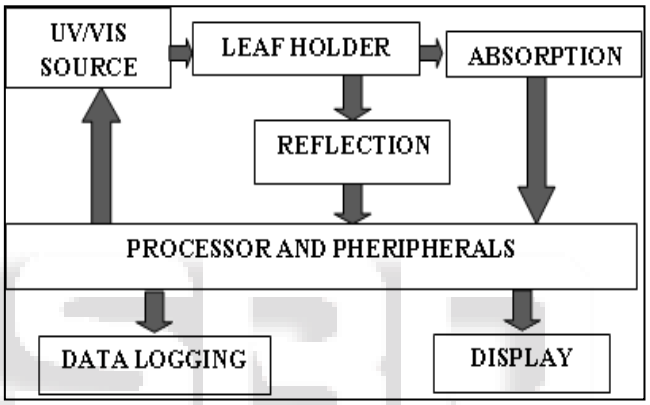

Fig. 1: Block diagram representation of the method

This process will continue for reflection property analysis also. In this way, the absorption and reflection properties of the given leafy vegetable are scanned both in UV and visible radiation band. Every mineral and or nutrient contents of the vegetable have uniqueness in terms of the wavelength at which it is sensitive to the absorption and reflection. The amount of absorption and reflection has the relationship with the concentration of that constituent.

IV. CONCLUSION

The experimental analysis and design of proposed method is underway by the authors. A strong data of both absorption and refection characteristics of some popular leafy vegetables are to be maintained in the processor for immediate reference with the measured data. A systematic correlation has to be made to make this instrument robust and reliable.

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